

## MESSAGE DEVICE

### FIELD OF THE INVENTION

5 This invention relates generally as indicated to a massage device and more particularly to a massage device for use in an unsupervised and unattended setting.

### BACKGROUND OF THE INVENTION

10 A massage has long been recognized as a pleasant means of treating stress, muscular aches, fatigue and other symptoms associated with an active life. A professional masseuse is typically employed to provide a massage and this professional is trained to provide pressure sensations by squeezing or kneading muscles or muscle groups in a certain way. Also, a professional masseuse will adapt the massaging technique to the person being massaged.  
15 For example, the masseuse will vary the time, intensity (*i.e.*, pressure level), the order of pressure sensations and/or the temperature of massage oil to accommodate a person's massage needs on a particular day. Furthermore, the hands of the masseuse are adaptable to fit almost every size person.

20 A massage applied by a professional masseuse is almost universally considered wonderful. However, the cost of having a professional masseuse constantly on call for periodic massages is outside most people's price range. For most people, a massage by a professional masseuse is only an occasional indulgence although our active lives justify more frequent, and perhaps daily, massages.

25 In the past, massage devices have been developed for medical purposes. For example, U.S. Patent No. 5,014,681 to Neeman discloses an apparatus for applying intermittent compression to a body part "for the purpose of stimulating blood flow in the limb so as to prevent pooling or stasis of blood in a bedridden patient or, alternatively for the purpose of treating edema, *i.e.*, the excessive  
30 accumulation of fluid in body fluids."

U.S. Patent No. 4,762,121 to Shienfeld discloses a device for massaging the limbs of a body that is "particularly useful in the treatment of lymphatic

disorders, such as congenital or secondary lymphedema in order to reduce excessive accumulation of fluids in the body tissue." Other possible applications for the Shienfeld device are "in the treatment of venous disorders, such as painful varicose veins, chronic venous insufficiency, an ulcer cruris" and "in the treatment of paralysis of the lower limbs because of long-standing muscular inactivity, and in the prevention of deep vein thrombosis during and after surgical operations."

U.S. Patent Nos. 5,245,990 and 5,383,842 to Bertinin discloses an apparatus "for improving or enhancing venous circulation in persons having venous insufficiencies and for providing muscular massage to prevent muscle atrophy" thereby "to facilitate rehabilitations of injured body parts by promoting venous body flow."

U.S. Patent No. 5,109,832 to Proctor discloses a medical apparatus "to apply compressive forces to a portion of a body for the therapeutic purpose of enhancing venous blood flow to prevent venous thrombosis and pulmonary embolism in surgical patients."

U.S. Patent No. 5,052,377 to Frajdenrajch discloses an apparatus "adapted to be arranged in contact with a part of the body of a patient in order to achieve thereon a succession of local pressures progressing in the direction of lymphatic drainage to be effectuated."

U.S. Patent No. 5,022,387 to Hasty discloses an antiembolism stocking for applying compressive pressures against a patient's limb to counteract pooling or stasis of blood which is particularly pronounced "during surgery, immediately after surgery, and when the patient has been confined to bed for extended periods of time." U.S. Patent No. 4,029,087 to Dye discloses a device designed for similar purposes.

U.S. Patent No. 4,865,020 to Bullard discloses a medical apparatus to improve blood movement to improve capillary circulation and which "may be useful in those conditions in which there is inadequate blood circulation, including Alzheimer's disease (lack of brain blood circulation), kidney malfunctions, and blood capillary circulatory problems, such as loss of hair color and loss of hair growth."

U.S. Patent No. 5,092,317 to Zelikovski discloses a method for use by "on the limbs of sportsmen, athletes, dancers, etc. after having being subject to extreme exertion." The effective purpose of the Zelikovski invention is "to squeeze or milk out from the muscle the generated and accumulated metabolites" and "to accelerate the normal venous return flow so as to accelerate the evacuation/dissipation of the thus squeezed out metabolites."

The massage devices discussed above have many different designs tailored for their particular medical objective. Many of these devices include a garment for enclosing the body part and an inflation assembly. The garment has a plurality of bladders arranged along the garment to massage the body part; and the inflation assembly supplies fluid pressure to each of the bladders to inflate the respective bladders.

The garments/sleeves of these prior art devices probably perform acceptably well for their intended uses. Specifically, for example, since the device is used in a hospital setting, trained medical personnel are available to insure a proper fit of the garments/sleeves on the patient. Additionally or alternatively, in such a medical setting, it may be practical to have an inventory of sleeves/garments of different sizes to accommodate a variety of patient sizes. Further, the appearance of inflation tubing and/or the set-up of such tubing usually does not present any issues in a medical setting. As for the inflation assembly, complicated fluid-providing components and/or distributing components are common place in medical settings.

The inventor appreciated that a massage device intended for use in an unsupervised and unattended setting (such as in-home use) could have many advantages and applications. The inventor further appreciated, however, that many of the features of a massage device which are perfectly acceptable in a supervised medical setting, would not be satisfactory in an unsupervised and unattended setting.

#### SUMMARY OF THE INVENTION

The present invention provides a massage device for massaging a body part of a person in an unsupervised and unattended setting. The massage

device comprises a garment for enclosing the body part, the garment having a plurality of bladders arranged along the garment to massage the body part, and an inflation assembly which supplies fluid pressure to each of the bladders to inflate the respective bladders.

5           The garment may be made of two opposing sheets with seams between the sheets defining the bladders. The sheets may be made of a material which is lightweight, durable and easily cleanable, such as urethane film. For example, the outer sheet may be urethane film supported on a laminate and the inner sheet may be unsupported urethane film.

10           The inflation assembly may include fluid-providing components, fluid-distributing components, control components, protection components, a display panel, and a power supply. These components of the inflation assembly may be contained within a housing which is sized and shaped to be compatible with unsupervised and unattended use of the massage device. The fluid-providing components could include a compressor, the fluid-distributing components could include a manifold and valves, and the control components could include a micro-controller, a user input interface, and valve drivers. In such a design, the compressor would provide a flow of inflation fluid to the manifold, the drivers would open/close the valves (e.g., activate/deactivate solenoid valves) so that the fluid within the manifold flows through the appropriate valve and to the appropriate bladder in the garment. The drivers could be controlled by the micro-controller based on input through the user input interface.

15           According to one embodiment of the invention, the garment has a "one-size-fits-most" design extremely beneficial for use of the massage device in an unsupervised and unattended setting. To this end, the garment may be shaped to accommodate the lower leg portion of the user's body with an opening for receipt of the user's heel. In this case, the garment could have, for example, four bladders which massage the user's foot and eight bladders which massage the user's calf, for a total of twelve bladders. In order to provide a snug fit to the user, the sheets may include a notch on each lateral separating the bottom bladders from the top bladders whereby the garment may provide a snug fit to user. Additionally or alternatively, the garment includes a loop fastening strip and

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a complimentary hook fastening strip which, when engaged with each other, form a hook-and-loop attachment. The loop fastening strip could be secured to the inner sheet and the hook fastening strip could be secured to the outer sheet. The loop fastening strips may be secured to the inner sheet laterally inward from pull handles and over and laterally beyond a tubing pocket and the hook fastening strip may be secured to the outer sheet adjacent its longitudinal edge.

In this manner, the garment can be fit to a range of foot widths and leg girths to accommodate users of different sizes and a very broad range of adjustment combinations are possible with the garment instead of simply a large, medium and small adjustment settings. The ability of the garment to provide a snug custom fit to a user results in improved sensation, quicker inflation dynamics, reduced inflation flow requirements (thereby decreasing pump/valve/tubing sizing and minimizing air flow requirements), compacted time lag from a deflated state to a maximum pressure state, and increased time at maximum massage pressure. The snug custom fit of the garment also reduces the inflated size of the bladders thereby maintaining the proper fit of the garment throughout the inflation process.

According to another embodiment of the invention, the bladders have approximately the same inflated volume thereby equalizing the inflation volume of the respective bladders. In this manner, substantially even inflation timing, with substantially even applied pressure, and, thus, overall smooth massage dynamics may be provided without overly complicated inflation fluid control. Approximately uniform inflated volumes are accomplished by necking seams in at least some of the bladders and the decreased volume in the necked bladder(s) is accomplished without decreasing the sensation of the necked bladder(s). For example, the necked shape of each of the bladders does not substantially change the original, overall, shape of the unnecked bladder (e.g., rectangular) so that substantially the same massage sensation is delivered. If the garment is shaped to accommodate the lower leg portion of the user's body, the top bladders circumscribing the user's calf could be necked and the bottom bladders circumscribing the user's foot could be unnecked.

According to another embodiment of the invention, the garment may include a pocket having an opening communicating with the respective bladders and wherein the inflation assembly including a source of inflation fluid and tubing extending from this source into the pocket. The enclosure of the tubing in the pocket provides a "clean appearance" compatible with in-home use of the massage device. Also, the enclosure and the pre-purchase setup of the tubing eliminates any what-tube-where confusion during in-home use of the massage device.

According to another embodiment of the invention, the inflation fluid may flow through throttled exhaust lines during deflation of the bladders. The throttling rate may be the same or may vary between respective bladders. Additionally or alternatively, the inflation assembly may include a zone selector which allows a user to select a certain zone of the garment thereby allowing concentration on a particular zone of the user's body. The zones may be preset or may be user-defined. If the garment is shaped to accommodate the lower leg portion of the user's body, for example, the bottom bladders that massage the user's foot could be grouped as a first foot zone and the top bladders that massage the user's calf could be grouped in a second lower calf zone and a third upper calf zone.

These and other features of the invention are fully described and particularly pointed out in the claims. The following descriptive annexed drawings set forth in detail certain illustrative embodiments of the invention, these embodiments being indicative of but a few of the various ways in which the principles of the invention may be employed.

### DRAWINGS

Figure 1 is a prospective view of a massage device according to the present invention being used in an unsupervised and unattended setting, the massage device including a garment and an inflation assembly.

Figure 2A is a prospective view of the garment in a wrapped condition, the garment including an outer sheet and an inner sheet.

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Figure 2B is a plan view of the garment in an unwrapped condition with its outer sheet face up.

Figure 2C is a plan view of the garment in an unwrapped condition with its inner sheet face up.

5        Figure 3A is a schematic view of the garment and inflation assembly of the massage device.

Figure 3B is a schematic view of the components of the inflation assembly.

10       Figure 3C is a top view of the inflation assembly with the top wall of its housing removed to show interior components.

Figure 3D is a front view of the inflation assembly with its front display panel removed to show interior components.

Figure 3E is an enlarged front view of the front display panel of the inflation assembly.

15       Figure 4A is a graph showing the sequential inflation of garment bladders according to one inflation pattern.

Figure 4B is a graph showing the sequential inflation of garment bladders according to another inflation pattern.

20       Figure 4C is a graph showing the sequential inflation of garment bladders according to another inflation pattern.

#### DETAILED DESCRIPTION

Referring now to the drawings, and initially to Figure 1, a massage device 100 according to the present invention is shown in use in an unsupervised and  
25       unattended setting. The massage device includes a garment 200 for enclosing a body part and an inflation assembly 300 which supplies fluid pressure to the garment 200.

Referring to Figures 2A - 2C, the garment 200 is shown isolated from the other components of the massage device 100. The garment 200 comprises two  
30       opposing sheets 202 and 204 made of a suitable material, such as a material which is lightweight, durable, and easily cleanable with water and a mild cleanser. For example, the outer sheet 202 may be made of urethane film

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supported with a laminate of 70 x 100 denier nylon weave and the inner sheet 204 may be made of unsupported urethane film.

Each of the sheets 202/204 has lateral edges 206 and 208 and longitudinal edges 210 and 212. The lateral edges, or top and bottom edges, 206 and 208 follow a generally straight or slightly curved path. The longitudinal edge 210 follows a generally linear path except for a V-shaped notch 213 and two U-shaped notches 214 and 215. The longitudinal edge 212 follows a contoured path to form an extension including a tubing pocket 220 and pull handles 222 and has a corresponding V-shaped notch 216. The sheets 202 and 204 each have a roughly rectangular shape with an aligned opening to form a heel opening 224 in the garment 200.

The sheets 202 and 204 are welded together along lateral seams 230, 232 and 234 and longitudinal seams 236, 238 and 240. One of the lateral seams 230 is positioned along the sheets' top lateral edge 206 and another of the lateral seams 232 is positioned along the sheets' bottom lateral edge 208. The remaining lateral seams 234 (twelve in the illustrated embodiment) are positioned in an approximately parallel series throughout the length of the sheets 202/204. Longitudinal seam 236 is positioned laterally inward from the sheets' longitudinal edge 212, longitudinal seam 238 is positioned laterally inward from the seam 236, and longitudinal seam 240 is positioned along the sheets' longitudinal edge 210. Necking seams 242 are also provided for inflation-control reasons explained below. Although not specifically shown in the drawings, reinforcement seams may be provided around the opening-defining edges of the pull handles 222, around the defining edges of the heel opening 224, around the defining edges of V-shaped notches 213 and 216, and/or around the defining edges of U-shaped notches 214 and 215.

The lateral seams 230, 232 and 234 and the longitudinal seams 238 and 240 form a plurality of inflatable bladders 250. In the illustrated embodiment, the garment 200 includes twelve inflatable bladders 250A - 250L which are roughly rectangular in shape and arranged longitudinally along the length of the garment 200. The position of the bladders 250A - 250C corresponds to the foot location,

the position of the bladder 250D corresponds to the heel location, and the position of the bladders 250E - 250L corresponds to the lower leg location.

As indicated above, the bladders 250 are each roughly rectangular in shape. The bladders 250 are more particularly shaped so that they each have an approximately equal inflated volume. This may be accomplished by varying the spacing of the seams 234 and/or by the necking seams 242 which decrease the inflation volume of certain bladders. In the illustrated embodiment, the top eight bladders 250E - 250L are provided with necking seams 242. By equalizing the inflation volume of the respective bladders 250, substantially even inflation timing, with substantially even applied pressure, and, thus, overall smooth massage dynamics are provided without the need for overly complicated inflation fluid control.

Significantly, the decreased volume in the necked bladders 250E - 250L is accomplished without decreasing the sensation of a particular bladder. For example, the necked shape of each of the bladders does not substantially change the original, overall, shape of the unnecked bladder so that substantially the same massage sensation is delivered. In the illustrated embodiment, the necked bladders 250E-250L still maintain a generally rectangular inflation chamber so that substantially the same massage sensation is delivered.

The longitudinal seams 236 and 238 form the longitudinal sides of the manifold pocket 220 and the lateral seams 230 and 232 close the pocket's top and bottom sides. A series of openings 260 in the pocket 220 communicate with the respective bladders 250. The V-shaped slit 216 interrupts the pocket 220 at a location aligned with the seam 234 separating the bladders 250D and 250E.

As was indicated above, the pocket 220 houses certain components of the inflation assembly 300, namely tubing 310, introduced below. The openings 260 allow the tubing to communicate with the bladders 250 and the slots 262 and 264 provides an entry passage for the tubing 310 into the top and bottom portions of the pocket 220. Although not specifically shown in the drawings, the tubing may be connected to the bladders via an inflation "port", such as a push-on barb for the tubing attachment.

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or no longitudinal "shrinking" of the garment (which would occur if the garment material had to move outward from the limb during inflation) hence maintaining a proper fit during the entire massage.

The garment 200 may include other or further features to facilitate comfort and/or massage characteristics. For example, padding may be provided on the inner surface of the manifold pocket 220 as a cushion between the inflation components housed in the pocket and the user's leg and foot. Additionally, non-slip grid elements may be placed on the outer sheet 202 on the portion of the garment 200 which is positioned beneath the user's foot. Further, various sized holes may be punched through both inner and outer sheet 202/204, between any adjacent seams 234 or 242 to allow for ventilation. Still further, a moisture-wicking lining material may be applied to the surface of the inner sheet 204 for comfort.

It should be noted at this point that although the illustrated garment 200 is designed for use on a person's foot and leg, alternate garments are possible with, and contemplated by, the present invention. For example, the garment 200 may be designed in a similar manner to provide a snug custom-fit for other body parts, such as an arm (upper and/or lower with or without hand), hand only, thigh, foot only, neck and shoulders, and/or back. Additionally, garments may be used in alike combinations, for example both hands together, or in different combinations, for example, leg and thigh together.

Referring now additionally to Figure 3A, the inflation assembly 300 is shown connected to the garment 200. The components of the inflation assembly 300 are contained within a housing 302 which is sized and shaped to be compatible with in-home use of the massage device 100. In the illustrated embodiment, the housing 302 is rectangular in shape, is approximately ten inches wide, nine inches deep, and four inches high, and a handle 304 is provided to selectively prop the housing 302 at a desired angle on, for example, an end table positioned adjacent to a chair.

Connection tubes 310 extend from the inflation assembly 300 to the garment 200 and, more particularly, to the bladder openings 260a - 260l. As is best seen by referring additionally to Figures 2B and 3B, the tubes 310a - 310d

extend into the lower portion of the pocket 220 and the tubes 310e - 310l extend into the upper portion of the pocket 220. The enclosure of the connection tubes 310 in such a pocket 220, provides a "clean appearance" compatible with in-home use of the massage device 100. Also, the enclosure and the pre-purchase setup of the tubing 310 eliminates any what-tube-where confusion during in-home use of the massage device 100.

As is shown schematically in Figure 3B and/or in Figures 3C and 3D, the inflation assembly 300 incorporates the fluid-providing components (a compressor 320, and an air filter 322 when air is used as the pressurizing medium), fluid-distributing components (a manifold 324, valves 326a - 326l) control components (micro-controller 328, user input interface 330, valve drivers 332), protection components (pressure relief valve 334, audio and/or visual alert 336), a display panel 338, and a power supply 340 for providing power to relevant components.

During operation of the massage device 100, the compressor 320 provides a flow of inflation fluid (air filtered through the filter 322) to the manifold 324. The valve drivers 332 open/close the valves 326 so that the fluid within the manifold flows through the appropriate valve and to the appropriate bladder 250 in the garment 200. In the illustrated embodiment, the valves 326 are solenoid valves whereby the drivers 332 are solenoid drivers which activate/deactivate the solenoids.

The compressor 320 of the inflation assembly 300 may be one which provides a substantially constant inflation capacity to each of the bladders. As was explained above, a substantially constant velocity and magnitude pressure wave along the garment 200 is accomplished by varying the geometry of the bladders 250. By providing uniform inflation characteristics of the bladders 250 with a substantially constant inflation capacity, a more uniform, repeatable, predictable, and satisfying massage action can be obtained. Further, more economical, more compact, and/or more reliable inflation components, such as compressors and valves, may be used.

During inflation of the garment bladders 250, inflation fluid flows through the tubing 310 to the appropriate bladder 250. During deflation of the garment

bladders 250, the inflation fluid flows through the tubing in the reverse direction and through exhaust lines 350. In the illustrated embodiment, the exhaust lines 350 include a throttling device (such as the illustrated orifice restriction) to provide a repeatable and gradual deflation rate for the bladders. If necessary for  
5 uniformity, the throttling rate (or orifice size in the illustrated embodiment) may vary between respective bladders.

The solenoid drivers 332 are controlled by the microcontroller 328 based on input through the user input interface 330. The microcontroller 328 may be programmed to inflate the garment bladders 250 in such a manner that there is  
10 smooth transition from one bladder to the next during the massage process. For example, the deflation of the first bladder 250A may be throttled so that the inflation of the next bladder 250B is underway prior to complete deflation of the first bladder. (Figure 4A.) The same effect may be accomplished without a throttled deflation, but the inflation of the next bladder must begin earlier in the  
15 timing sequence. (Figure 4B.) Alternatively, the inflation of the next bladder may be delayed until the previous bladder is completely deflated. (Figure 4C.)

As shown in Figure 3E, the user input interface 330 and the user display 338 are incorporated into a display panel 360. The display panel 360 includes a zone selector 362 which, via the user input interface 330, allows a user to select  
20 a certain zone of the garment 200. This zone selection allows concentration on a particular zone of the user's body, such as the foot, the lower calf, or the upper calf. In the illustrated embodiment, for example, the garment bladders 250A - 250D are grouped in a first "foot" massage zone, the garment bladders 250E- 250H are grouped in a second "lower calf" massage zone, and the garment  
25 bladders 250I - 250L are grouped in a third "upper calf" massage zone. Thus, illustrated display panel 360 allows the user to select the desired preset massage zone. However, an inflation assembly 300 wherein user-definable zones may be input (such as a middle calf zone) are possible with, and contemplated by, the present invention.

30 The display panel 360 additionally includes an intensity selector 364, a time selector 366, and a power switch 368. The intensity selector 364 allows a user to input a setting in the range of the interrelation between speed and

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pressure and this input is provided, via the interface 330, to the micro-controller 328 to appropriately control the solenoid drivers 332. With a substantially constant capacity inflation assembly 300, there is an inverse relationship between pressure within the massage pressure wave. Specifically, the faster the massage pressure wave travels the lower the applied pressure within the massage pressure wave and vice versa. The pressure relief valve 334 limits the maximum pressure that can be developed and therefore delivered to the garment 200. To this end, the valve 334 should be inaccessible to the user and tamper proof.

The time selector 366 allows a user to choose a time period for the massage session and this input is provided, the interface 330, to the micro-controller 328. This selector 366 includes an uppermost setting (thirty minutes in the illustrated embodiment) to prevent over use of the massage device 100. Upon completion of the massage session, the audio and/or visual alert 336 alerts the user of the end of the massage session. The power switch 368 activates or deactivates the power supply 340.

The display panel 360 or other suitable component of the massage device 100 may include a "hold" input 380 which, upon activation by the user, provides continuous pressure (or continuous pulsating pressure) in a selected garment chamber or chambers thereby providing concentrated action on a particularly tense portion of the body.

One may further appreciate that although the invention has been shown and described with respect to a certain preferred embodiment, obvious and/or equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification. The present invention includes all equivalent alterations and modifications and is limited only by the scope of the following claims.